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Renewable Energy Decisions

Adam Warren, PhD

NREL
Transforming ENERGY

Renewable Energy Decisions

Adam Warren, PhD
Director, Integrated Applications Center

National Lab Day
Montana Technological University
Butte, Montana

NREL at a Glance

Golden, CO

NREL at a Glance

2,050

Employees,
plus more than
500
early-career researchers
and visiting scientists

$480M

Budget
with support from
DOE, other federal
agencies, & industry

nearly 820

Partnerships
with industry,
academia, and
government

Campus
operates as a
living laboratory

NREL's Science Drives Innovation

Renewable Power

- Solar
- Wind
- Water
- Geothermal

Sustainable Transportation

- Bioenergy
- Vehicle Technologies
- Hydrogen

Energy Efficiency

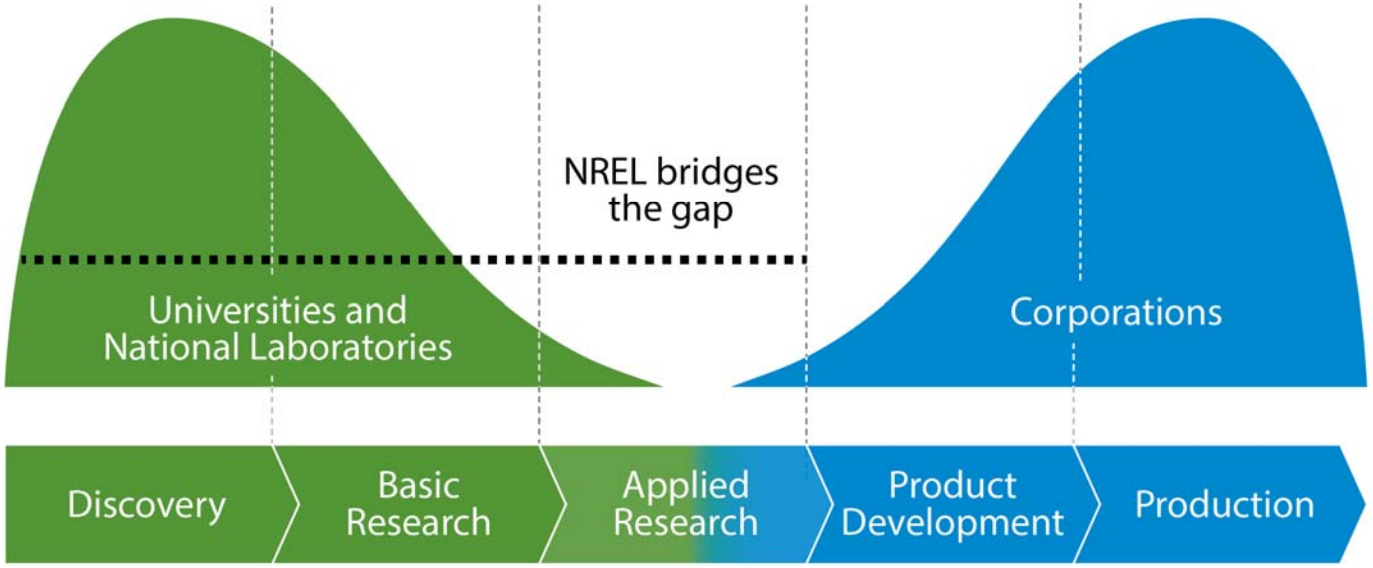
- Buildings
- Advanced Manufacturing
- Government Energy Management

Energy Systems Integration

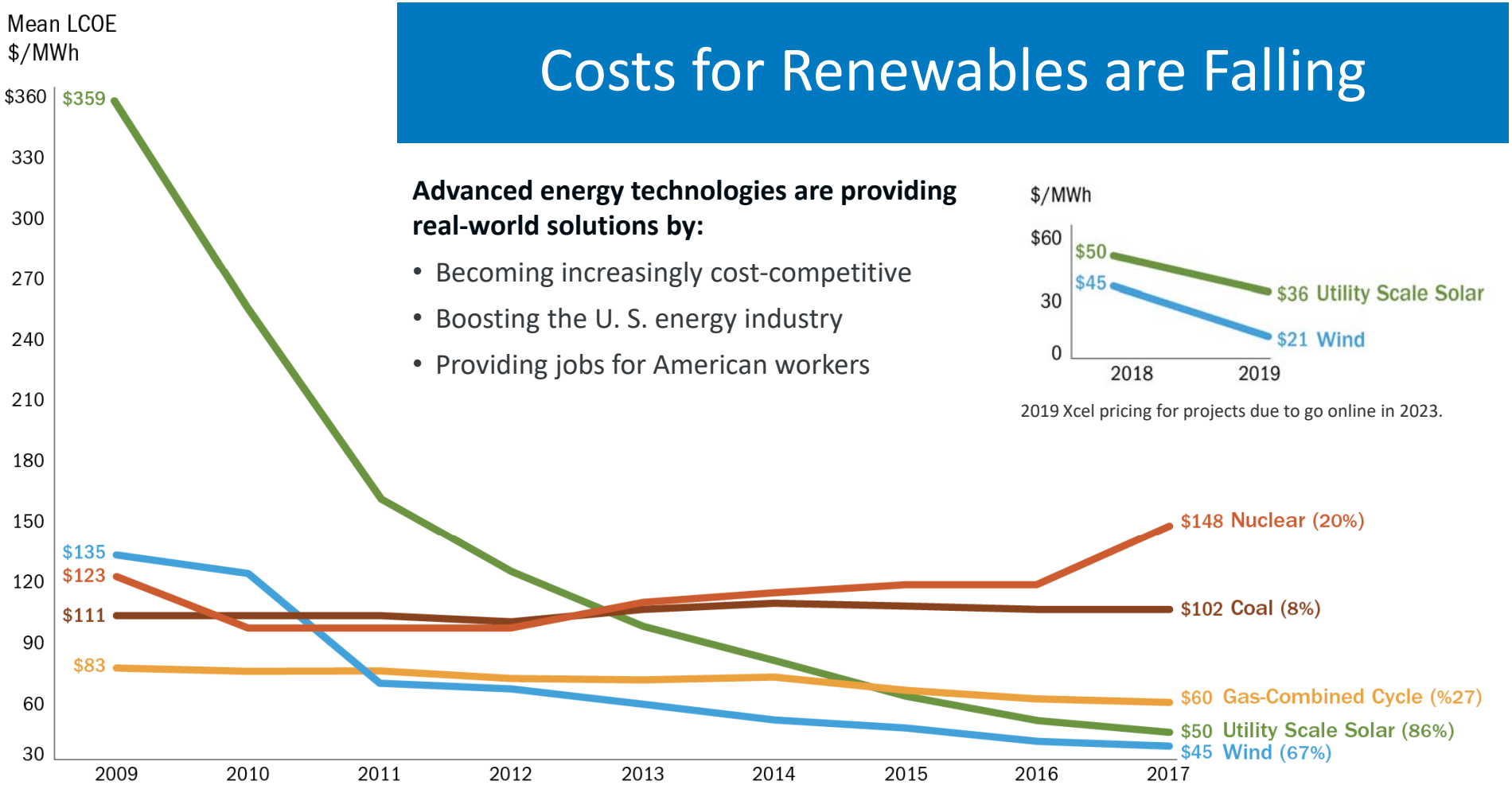
- High-Performance Computing
- Data and Visualizations

We Reduce Risk in Bringing Innovations to Market

- NREL helps bridge the gap from basic science to commercial application
- Accelerated time to market delivers advantages to American businesses and consumers



Costs for Renewables are Falling



Advanced energy technologies are providing real-world solutions by:

- Becoming increasingly cost-competitive
- Boosting the U. S. energy industry
- Providing jobs for American workers

2019 Xcel pricing for projects due to go online in 2023.

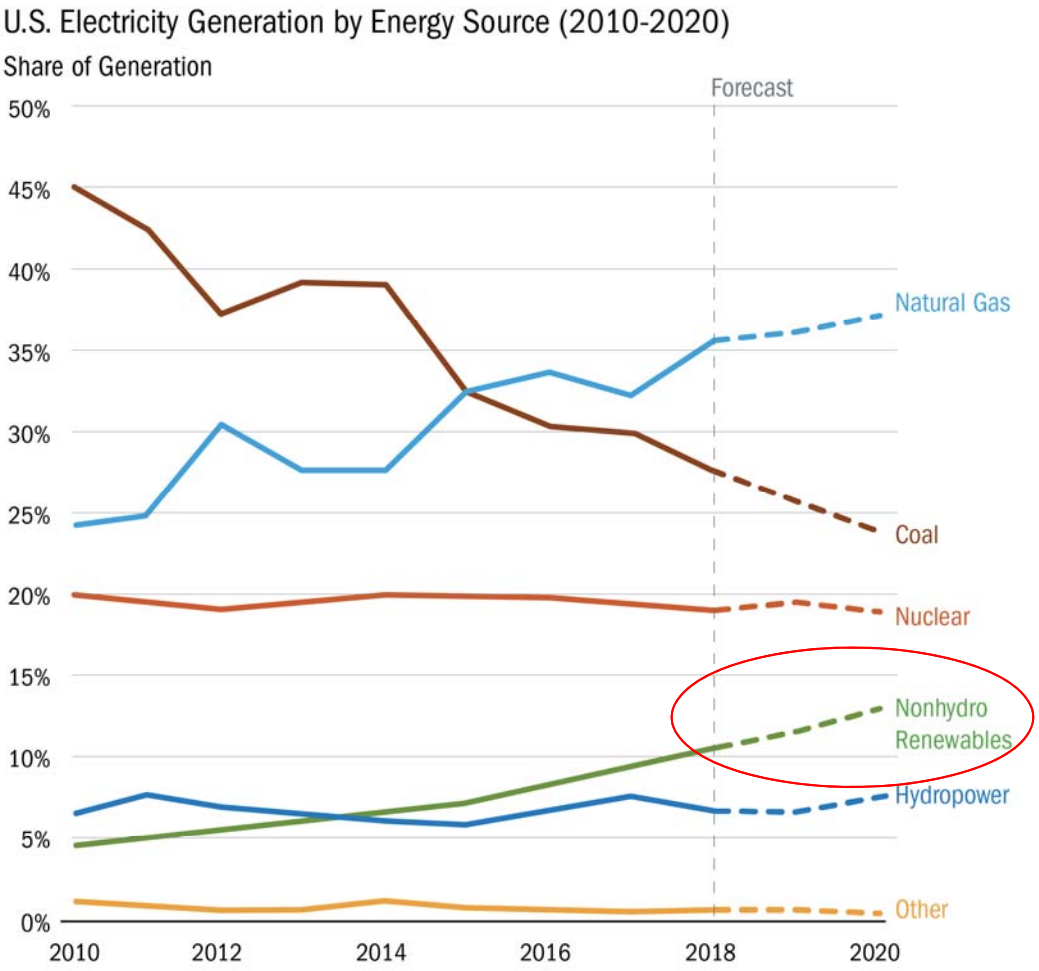
Source: *Lazard's 2017 Levelized Cost of Energy Analysis,* Version 11, 2 November 2017

U.S. Energy Supply is Shifting

Non-hydro RE currently produces 10% of the total U.S. electricity generation. Within the next two years, this is expected to grow to 13%.

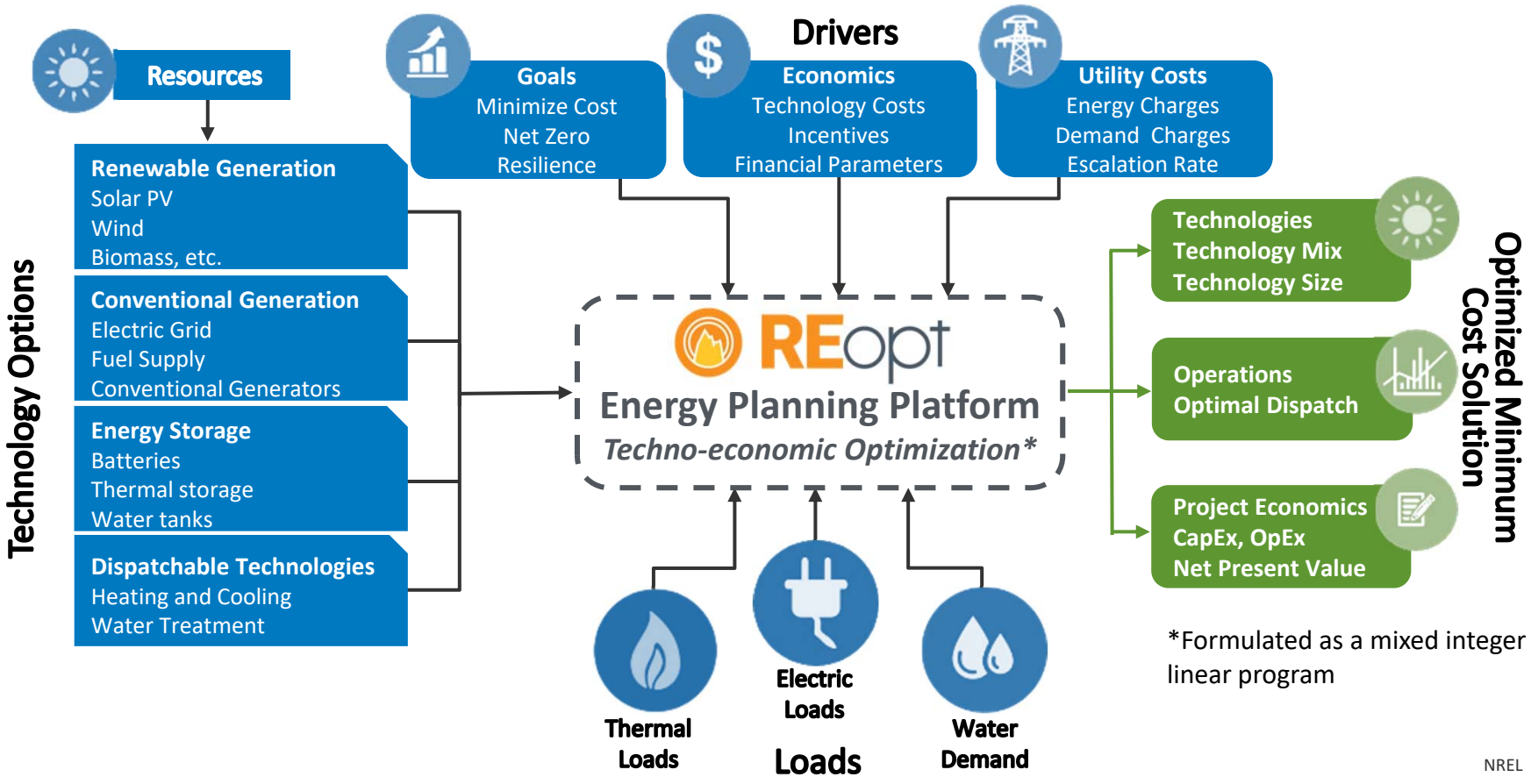
Generation will be increasingly distributed, with 31% of new capacity behind-the-meter.

Achieving this transformation will require increasingly integrated and complex solutions, and the tools to



Source: United States Energy Information Agency, *Today in Energy,* 18 January 2019

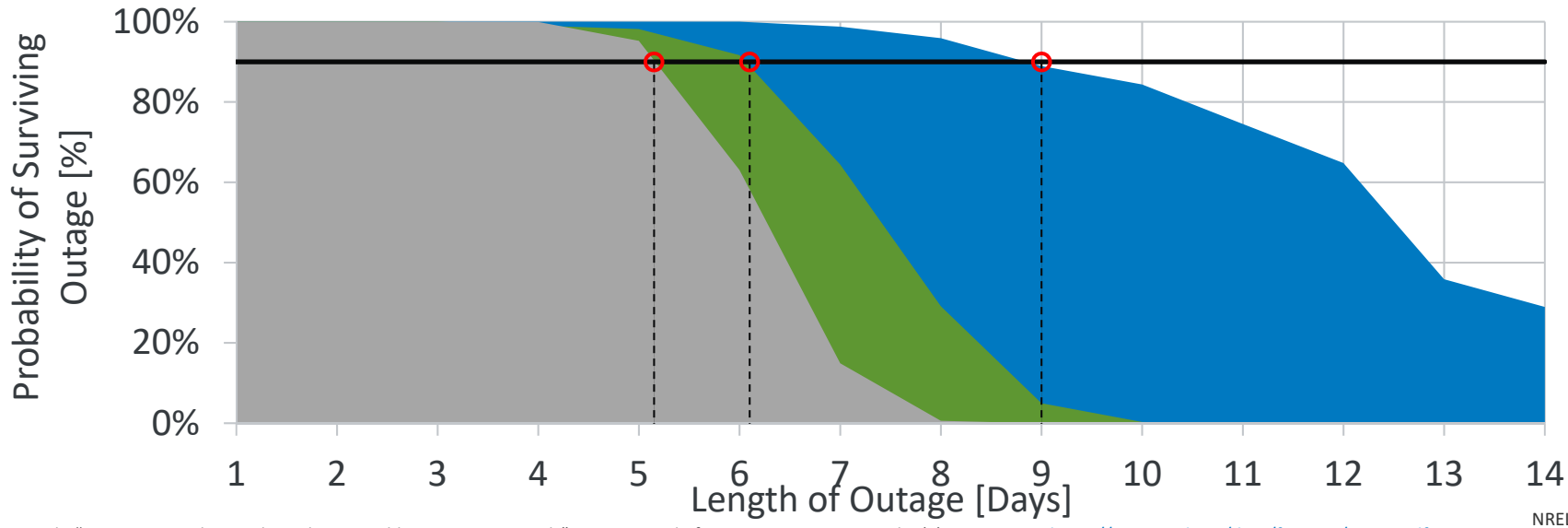
REopt Platform Inputs and Output



*Formulated as a mixed integer linear program

Increasing Resilience

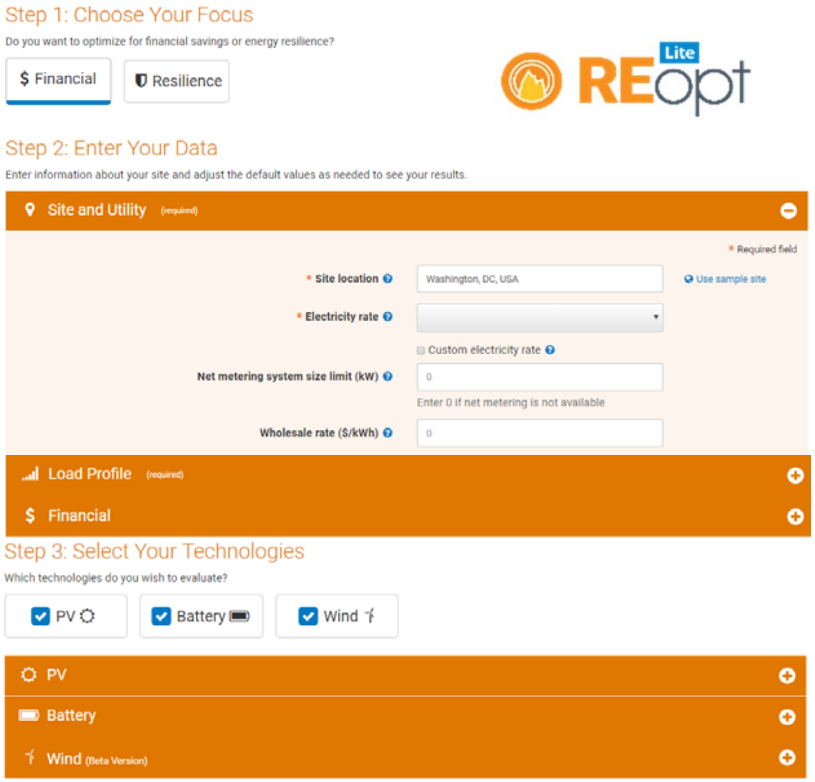
	Generator	Solar PV	Storage	Lifecycle Cost	Outage
1. Base case	2.5 MW	-	-	$20 million	5 days
2. Lowest cost	2.5 MW	625 kW	175 kWh	$19.5 million	6 days
3. Proposed system	2.5 MW	2 MW	500 kWh	$20.1 million	9 days



K. Anderson et al., "Increasing Resiliency Through Renewable Energy Microgrids". SCTE Journal of Energy Management Vol.2 (2) August 2017 https://www.nrel.gov/docs/fy17osti/69034.pdf

REopt Lite Web Tool

- **REopt Lite** web tool provides access through a web interface that is easy to use
- **Financial mode** optimizes PV, wind and battery system sizes and battery dispatch strategy to minimize life cycle cost of energy
- **Resilience mode** optimizes PV, wind, and storage systems along with exiting back-up generators to sustain critical load during grid outages



https://reopt.nrel.gov/tool

Impact of E-Buses in Missoula, MT

- In this analysis, NREL used the REopt model to evaluate the economics of charging six electric buses purchased by the City of Missoula, Montana

- Evaluates potential of adding solar PV and lithium-ion battery storage to mitigate the costs of charging the electric bus fleet

Solar Energy Innovation Network: https://www.nrel.gov/solar/solar-energy-innovation-network.html
Montana Solar Powered Community Transportation Initiative: https://www.nrel.gov/solar/solar-energy-innovation-network-round-1.html#paneld10e178_3

Thank you!

adam.warren@nrel.gov

www.nrel.gov

SEIN Overview

SOLAR ENERGY INNOVATION NETWORK
U.S. DEPARTMENT OF ENERGY

- This analysis was conducted under the first round of the Solar Energy Innovation Network (SEIN), a program led by the National Renewable Energy Laboratory (NREL) that assembles diverse teams of stakeholders to research solutions to real-world challenges associated with solar energy adoption.
  - Through SEIN, NREL researchers work with multi-stakeholder teams over the course of 15-18 months on novel applications of solar
  - Teams receive a) direct funding, b) analytical support, and c) coaching and workshop facilitation support, including several in-person working session at NREL.
  - Funded by DOE SETO
- This analysis supported the efforts of the Montana Solar Powered Community Transportation Initiative, a team consisting of :
  - The Montana Renewable Energy Association
  - Montana Energy Office at the Department of Environmental Quality
  - Climate Smart Missoula
  - City of Missoula, City of Bozeman, City of Whitefish
- The team is investigating the synergies between solar generation and electric vehicle (EV) charging, including the potential opportunities and challenges related to co-locating solar energy and charging infrastructure to reduce costs and enhance co-benefits of the electrification of transportation.
- The City of Missoula's transit agency has purchased six electric buses. This analysis supports the team's efforts to understand the potential costs and specific options for using solar and storage to reduce EV bus charging costs.

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How does REopt Work?

- REopt considers trade-off between capital costs and cost savings across multiple value streams to recommend optimal size and dispatch
- Results show 12.4 MW PV system with 2.4 MW/3.7 MWh battery storage can provide $19.3 million net present value
  - A smaller system would be cheaper, but provide less value
  - A larger system would provide more savings, but be more expensive
- Battery is only economical when paired with PV at this site due to wide peaks